

Application of the NAO humanoid robot in the treatment of bone marrow-transplanted children (demo)

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Abstract

This demo presents some acts of a potential application of NAO humanoid robots under special circumstances in a hospital, including results of experiments performed at the Children's Hematology and Stem Cell Transplantation Unit of Szent László Hospital in Budapest, Hungary. Children in this unit are forced to live in small 2x3 m sterile boxes where NAO can be a good companion to cheer them up and break their usual daily routine with performances and exercise.

Index Terms: humanoid robot, children-robot interaction

1. Introduction

Robots have gained increasing popularity in the medical domain [1][2][3]. One example is using robots as a tool in operations [4] where the efficiency of the doctors' work is increased. At the Children's Hospital of Orange County "the robot doctor" [5] allows the specialist to provide services at multiple locations. In the framework of the ALIZ-E project a humanoid robot will support the treatment of diabetic children [6]. Robots contribute to the study of autism, too. Villano et al. [9] use a humanoid robot as an aid in a Wizard of Oz experiment.

Our goal is to design and implement a proper human-computer interface for ill children. We did not want to design a new robot, so the NAO robot [8] was chosen which has proper support and a development environment with high level functionality. There are already successful applications of NAO humanoid robots in hospitals [7][9][10] and it can collaborate well with real and virtual components [11].

NAO is an easily programmable, 57 cm high humanoid robot with 25 degrees of freedom granted by DC motors. The robot is equipped with several sensors. The speech synthesizer originally speaks English, French and Japanese, but we have ported our ProfiVox [12] system to this platform so it speaks fluent Hungarian, too.

A detailed paper of the topic of this demo was presented at the CogInfoCom 2012 conference in Kosice, Slovakia (<http://dx.doi.org/10.1109/CogInfoCom.2012.6421933>).

2. Determination of requirements

The Children's Hematology and Stem Cell Transplantation Unit of Szent László Hospital is a place where severely ill children are fighting for their life every day, but due to their conditions they are lacking activity and companion. The working area has some essential requirements (c.f. Fig. 1). Due to their condition patients are not allowed to leave their little cells, where absolute sterility is required. NAO's operation area is about a circle with a diameter of 1 meter.

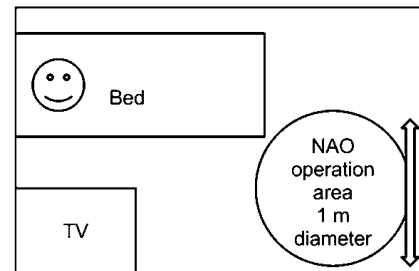


Figure 1: NAO operation area.

3. Demonstration prototype

After consulting with the doctors and the psychologist four 1-2 minute-long acts have been constructed, each one helping to make usual daily tasks more exciting. These acts deal with eating, medication, waking up in the morning and bathing (c.f. Fig. 2).

Eating is important for patients for their recovery, but some medicines may reduce the appetite drastically. To motivate the children NAO acts as if its stomach was growling, starts eating, even burping, which caused patients to burst out in laugh.

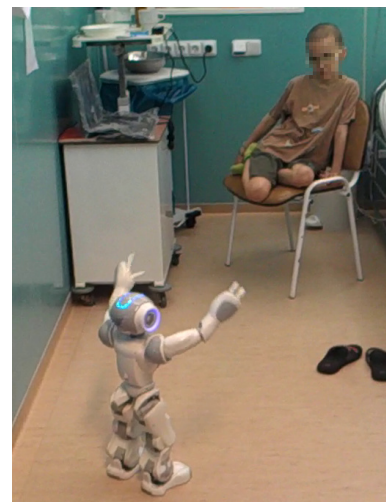


Figure 2: NAO in action.

Medication is the other critical part of recovery, and many children have revulsion against medicines because of their non-natural appearance and bitter taste. In the medication act NAO acts as if medicines were lost and NAO is eager to find them, describing medicines as little heroes fighting against evil diseases and viruses. During the search phase NAO walks

around up and down, squats, highlighting how important it is not to lose a single pill.

For the daily exercises and visits waking up in time is preferential. To make it easier NAO welcomes the children in the morning, and performs a short morning exercise, that can easily be done by any child.

Bathing is something that children often dislike. It can be particularly uncomfortable when they have to do it in a basin. In this act NAO walks in whistling, imitating taking a shower and singing.

Another improvement is using NAO's built-in image recognition function for new features. This function can be used in many ways. With sterilizable image cards it can be used for a game. It also provides the opportunity of using NAO for learning. As an exercise it can be used for learning foreign languages or characters/letters. NAO may ask for a foreign word or a character/letter and the child's task is to show NAO the right image card. This function is already partially implemented.

4. Conclusion

This demo presents a new and promising area of cognitive infocommunications. Humanoid robots may contribute to the treatment of severely ill – bone marrow transplanted – children by providing motivation and joy. Our initial experiments have shown that all parties involved in the experiments (medical staff, children and parents) gave fully positive feedback for the idea.

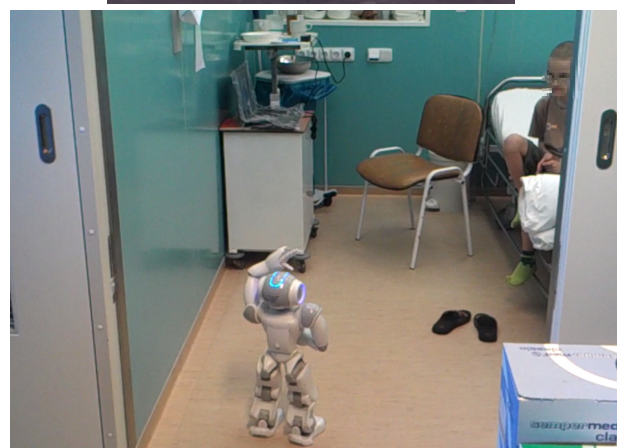
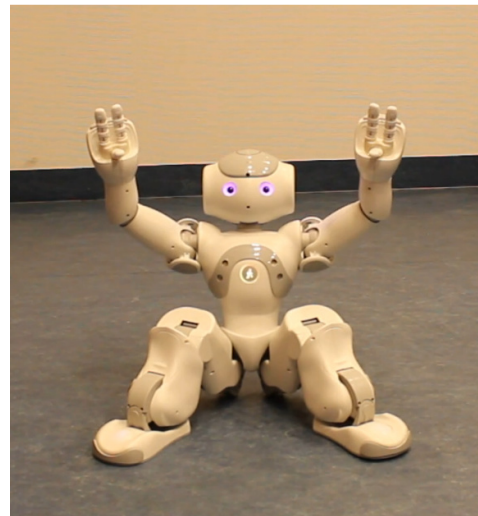
Although even one-way dialogue is helpful, the real advantages of this scenario can be exploited through multimodal, two-way interactions only. This initial study is just the beginning. Several further research steps are to be performed, including real, personalized interaction, definition of the robot's role, etc. in order to reach real-world application of this concept. We are looking for partners for our future research in these directions.

We also plan to expand our humanoid robot – human interaction for elderly people. There are a lot of similar problems and tasks of both children and single elderly people. The robot can be connected to a digital personal living assistant which triggers the motivation scenes or the humanoid robot can give emotional feedback to elderly people's actions.

5. Acknowledgements

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6. Sample pictures from the motivation scenes



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